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# **Abstract**

**This is an ex parte presentation to the FCC, explaining 802.22's charter, studies and conclusions to date, goals, etc.**

**This document was approved by the IEEE 802.22 WG, the IEEE 802.18 RR-TAG, and the IEEE 802 Executive Committee and represents the views of IEEE 802. It does not necessarily represent the views of the IEEE as a whole or the IEEE Standards Association as a whole .**

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# IEEE 802.22 WG Scope and Purpose

- **The IEEE 802.22 WG on Wireless Regional Area Networks (“WRANs”) has the following charter, per its approved PAR:**
  - To develop “Cognitive Wireless RAN Medium Access Control (MAC) and Physical Layer (PHY) specifications” ... “(specifying) the air interface, including the medium access control layer (MAC) and physical layer (PHY), of fixed point-to-multipoint wireless regional area networks operating in the VHF/UHF TV broadcast bands between 54MHz and 862 MHz.”
  - “This standard is intended to enable deployment of interoperable 802 multivendor wireless regional area network products, to facilitate competition in broadband access by providing alternatives to wireline broadband access and extending the deployability of such systems into diverse geographic areas, including sparsely populated rural areas, while preventing harmful interference to incumbent licensed services in the TV broadcast bands.”
  - Goal is a global standard, capable of use in different regulatory domains where other TV technologies are used (DVB, PAL, SECAM, etc.)

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# Background

- **The IEEE 802.22 WG started as a Study Group in the IEEE 802.18 RR-TAG (approved November 2003)**
  - We noted the Commission's interest in the possibility of making unused TV spectrum available for use by license-exempt devices, starting with the Spectrum Policy Task Force, NOI ET Docket No. 02-380, etc.)
  - We thought it prudent to begin studies on how this spectrum might best be put to use, should it become available.
  - We wanted to explore the issues surrounding coexistence/non-interference with the licensed incumbents.
  - All interested stakeholder communities were represented in the Study Group and are actively participating in the 802.22 WG (MSTV, NAB, CEA, wireless microphone interests, PLMRS interests, and “traditional” IEEE 802 participants)
- **The PAR for the 802.22 WG was approved in September 2004, the WG held its first meeting in November 2004, and has been meeting regularly since then.**

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## **802.22 Standard Project Timeline**

- Requirements definition** **July 05**
- Rcv/eval proposals/contributions** **Sept/Nov 05**
- Consolidation of Proposals** **Jan 06**
- WG Draft Process Start** **Jan 06**
- To Sponsor Ballot** **Jan 07**
- Final Approval** **July 07**
- Publication** **Sept 07**

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## **802.22 Progress to Date**

- **The following slides will summarize the results of our studies and discussions to date – many of which have resulted in broad agreement and point to the need for somewhat different requirements and methodologies than were outlined by the Commission in its NPRM ET Docket No. 04-186 in order to provide reliable protection to licensed services.**

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# WRAN System Modelling and Analysis

1. For the purposes of deriving WRAN system Requirements, a model for CPE operation within the Grade B/noise-limited contour was agreed upon:
  - a. For TV, the analysis for sensing a DTV signal is the worst case (harder to detect than NTSC)
  - b. WRAN operation on N and N+/-1 within the Grade B/noise-limited contour was excluded for TV, Wireless microphone operations, and channels 14-20 for PLMRS where authorized
  - c. The DTV analysis must include receiver saturation as well as adjacent channel interference at N+/-2 and beyond
  - d. The criteria for DTV “interference” is to not reduce the sensitivity of the receiver by more than 1 dB
  - e. The CPE antenna is located outdoors, at least 10 meters above ground and 10 meters from the nearest DTV receiving antenna. (Agreement on an indoor-to-outdoor absorption ratio was not necessary since both CPE and DTV antennas were located outdoors.)
  - f. The DTV antenna is oriented toward the CPE antenna and there is 14 dB of polarization discrimination.
  - g. The CPE has 4 Watts of maximum EIRP
  - h. The CPE has an outdoor sensing antenna with a minimum gain of 0 dBi in all azimuthal directions and polarizations
2. It was agreed to impose the WRAN Requirements derived from the CPE model above onto Base Stations operating within the Grade B/noise-limited contour with the exception that the Base Station was assumed to be professionally installed.
3. Even though the sensing range of the WRAN system for wireless microphones is much smaller than the interference range, it was felt that the use of distributed sensing by CPEs would help mitigate the range disparity. Therefore, it was agreed that the CPE Requirements derived for DTV, other than the sensing threshold, would be acceptable for the case of the wireless microphones.

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# **Fundamental requirements for WRAN systems to protect TV broadcasting**

- **Fixed outdoor P-MP System with base station professionally installed at known location**
- **Base Station pre-programmed with disallowed channels based on pre-installation site survey/system engineering and with access to channel usage databases and manual over-ride for special temporary channel exclusion**
- **Customer Premises Equipment (“CPE”s) should include fixed outdoor antennas (RX, TX, and sensing), and be user-installable, though some operators may opt to require professional installation of CPEs**
- **Master/Slave relationship between base station and CPEs - Base Station controls CPE frequency of operation, TX power, modulation, timing, etc.**
- **Centralized cognitive radio approach to sensing/avoiding (protecting) incumbents to make system adaptive to changes in incumbent usage, environment, etc. (i.e., distributed sensing by all CPEs across the entire network cell w/centralized intelligence/control at the base station)**

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# **Fundamental requirements for WRAN systems to protect TV broadcasting**

- **Systems should not be allowed to operate on  $N$  or  $N \pm 1$  within the protected contour of a DTV station**
- **Need to consider DTV D/U's and DTV receiver saturation for  $N \pm 2$  channels and beyond and resulting possible need for an "EIRP profile" for WRAN devices**
- **Our studies indicate that Part 15.209(a) out-of-band emission levels are insufficient to protect DTV receivers for  $N \pm 2$  and beyond (by some 33 dB for 1 dB desensitization of DTV receivers)**
- **IEEE 802.22 anticipates recommending an out-of-band emission mask to the Commission, based on an agreed deployment scenario once D/U's are agreed for  $N \pm 2$  channels and beyond and an EIRP profile is specified**



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# **Distributed sensing and Master/Slave control (for TV protection)**

- **Base station initially programmed with “keep out” channels, based on site survey/system engineering**
- **During operation, base station has access to channel usage databases and the operator has manual over-ride for dynamic temporary channel exclusions**
- **Cognitive radio sensing threshold of -116 dBm in 6 MHz bw (based on sensing DTV pilot at 11.3 dB below total power in the channel), with sensing done by ALL CPEs and centralized intelligence/control at the base station (analog TV sensing requirements are less stringent)**
- **CPE antennas outside, sense antennas omni with 0dBi minimum gain at any sense of polarization**
- **CPEs may NOT transmit, absent receipt of a control signal from a base station**
- **Base station totally controls RF operation of CPEs**
  - Frequencies that may be used
  - Modulation, Timing, TX power control
  - Commands to perform sensing on used channel [during quiet periods?] or to scan other channels and report results
- **Adaptive ability of cognitive radio with distributed sensing and centralized control will help to preclude interference despite future changes in incumbent locations and channel assignments**

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# Fundamental requirements for WRAN systems to protect Part 74 licensed operations such as wireless microphones

- OOB emissions requirements agreed in 802.22 to be the same as required to protect DTV (15.209(a) not adequate)
- Cognitive radio sensing threshold of -107 dBm in 200 kHz bw for sensing wireless microphones recommended by IEEE 802 in its comments in the NPRM is a *best effort*, but is not sufficient to fully protect Part 74 wireless microphone operation since the interference range of the CPEs into wireless microphone receivers would be larger than their sensing range for wireless microphone transmitters
  - Can't differentiate between licensed Part 74 users and unlicensed users with current wireless microphone technology
  - Likelihood of false alarms from unlicensed wireless microphones would render WRAN operation susceptible to potential unintentional (and/or intentional) interference or "denial of service"
- Use of beacons by the Part 74 wireless microphone operators could alleviate problems with sensing and detection of licensed microphones as well as the identification and differentiation from unlicensed microphones. There exists a desire to distribute these devices in a manner familiar to the existing microphone manufacturers infrastructure while still providing strong mechanisms that ensure beacon operation by legitimate license holders in an authorized manner. We advocate that the Commission treat such beacons as devices licensed under Part 74.
- **The Commission should consider designating a limited number of TV channels per market that would not be available for unlicensed operation**
  - Part 74 users should be required by rule to use these preferentially
  - Fewer channels needed in more rural areas/smaller markets where WRAN is most needed
  - In unusual cases (major event in rural area), use of other than reserved channels allowable, but Part 74 users should coordinate to minimize avoidable impact on WRAN capacity

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# Additional Topics/Unresolved Issues

- **The Commission should avoid creating another “food-fight band,” - more order is required than “traditional Part 15 environment” – especially in bands where licensed incumbents exist**
- **Base station registration/light licensing???**
- **Any technology allowed to share in the TV bands must**
  1. Protect licensed incumbents to a very high degree of reliability
  2. Demonstrably coexist well with any other license-exempt technology allowed
  - Anything less will result in inefficiency, interference, and devalue the public value of license-exempt sharing in the TV bands – for example, possibility of (proprietary, stand-alone) DTV retransmission equipment (DVD player to monitor, etc.) or similar devices (outdoor security cameras) could VERY seriously compromise WRAN channel availability/system capacity and ability to provide broadband services to the public
- **There is a likelihood that IEEE 802.22 will develop a Recommended Practice for installation/deployment of .22 WRAN systems.**